CLAIMS

1	1. A dynamic gain flattening filter configured to receive an
2	optical signal, comprising:
3	a first filter stage including,
4	a first tunable coupling member;
5	a first differential delay with first and second tunable delay paths;
6	and
7	wherein the first tunable coupling member adjusts an amount of
8	power of the optical signal divided onto the first and second tunable delay
9	paths of the first differential delay.
1	2. The filter of claim 1, wherein the first differential delay
2	includes a fixed portion and a tunable portion.
1	3. The filter of claim 1, wherein the first differential delay
2	includes a first fixed differential delay and a first tunable differential delay
3	with respect to the first and second tunable delay paths.

- 1 4. The filter of claim 3, wherein the first fixed differential delay 2 sets a periodic variation in a power spectrum of the optical signal.
- 1 5. The filter of claim 3, wherein the first tunable differential 2 delay sets a phase of the periodic variation in the power spectrum of the 3 optical signal.
- 1 6. The filter of claim 3, wherein the first fixed differential delay is positioned between the first tunable coupling member and the first tunable differential delay.

1	7.	The filter of claim 3, wherein the first tunable differential
2	delay is posi	tioned between the first tunable coupling member and the first
3	fixed differe	ntial delay.
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1	8.	The filter of claim 1, further comprising:
2		a second stage including:
3		a second tunable coupling member;
4		a second differential delay with first and second tunable
5	delay paths;	and
6	wher	ein the second tunable coupling member adjusts an amount of
7	power of the	optical signal divided onto the first and second tunable delay
8		second differential delay.
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1	9.	The filter of claim 8, wherein the second differential delay
2	includes a fix	xed portion and a tunable portion.
1	10	
1	10.	The filter of claim 8, wherein the second differential delay
2	includes a se	cond fixed differential delay and a second tunable differential
3	delay with th	e first and second tunable delay paths.
1	11.	The filter of claim 10, wherein the second fixed differential
2		
<i>_</i>	uciay sets a p	periodic variation in a power spectrum of the optical signal.
1	12.	The filter of claim 10, wherein the second tunable differential
2	delay sets a p	phase of the periodic variation in the power spectrum of the
3	optical signal	l.
1	13.	The filter of claim 10, wherein the second fixed differential
2	delay is posit	ioned between the second tunable coupling member and the

second tunable differential delay.

- 1 14. The filter of claim 10, wherein the second tunable differential
- 2 delay is positioned between the second tunable coupling member and the
- 3 second fixed differential delay.
- 1 15. The filter of claim 3, wherein each of the differential delays
- 2 is a polarization dependent differential delay.
- 1 16. The filter of claim 3, wherein the first fixed differential delay
- 2 generates a time delay between first and second polarizations of the optical
- 3 signal.
- 1 The filter of claim 3, wherein the first tunable differential
- delay changes an optical phase between first and second polarizations of the
- 3 optical signal.
- 1 18. The filter of claim 3, wherein the first tunable coupling
- 2 member is a polarization state transformer that transform the incoming
- 3 signal beam from one polarization state to a different polarization state.
- 1 19. The filter of claim 3, wherein the first tunable differential
- 2 delay modifies first and second polarizations of the optical signal with
- 3 different phase relationships.
- 1 20. The filter of claim 3, wherein the first tunable coupling
- 2 member includes first and second liquid crystal alignment members coupled
- 3 to a voltage source.
- 1 21. The filter of claim 20, wherein liquid crystals in the first and
- 2 second liquid crystal alignment members are orientated at different angles
- 3 with respect to each other.

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- 1 22. The filter of claim 20 wherein liquid crystals in the first and 2 second liquid crystal alignment members are orientated at the same angle 3 with respect to each other.
- 1 23. The filter of claim 20, wherein liquid crystals in the first 2 liquid crystal alignment member are orientated orthogonal to liquid crystals 3 in the second liquid crystal alignment member.
- 1 24. The filter of claim 3, wherein the first tunable differential 2 delay includes first and second liquid crystal alignment members coupled to 3 a voltage application member.
- 1 25. The filter of claim 24, wherein liquid crystals in the first and 2 second liquid crystal alignment members are orientated at the same angle.
- 1 26. The filter of claim 24, wherein liquid crystals in the first and 2 second liquid crystal alignment members are orientated at different angles 3 with respect to each other..
 - 27. The filter of claim 3, wherein at least one of the tunable coupling members and the tunable differential delays is a liquid crystal tuning element.
- 1 28. The filter of claim 3, wherein at least one of the tunable 2 coupling members and the tunable differential delays is a Faraday rotation 3 member.
- 1 29. The filter of claim 3, wherein at least one of the tunable coupling members and the tunable differential delays is an electro-optic member.

1	30.	The filter of claim 3, wherein at least one of the tunable
2	coupling men	mbers and the tunable differential delays is a thermal tuning
3	member.	
1	31.	A dynamic gain flattening filter configured to receive an
2	optical signa	l, comprising:
3	a firs	t filter stage including,
4	a firs	t tunable coupling member;
5	a firs	t differential delay with first and second tunable delay paths;
6	where	ein the first tunable coupling member adjusts an amount of
7	power of the	optical signal divided onto the first and second tunable delay
8	paths of the	first differential delay and
9	a firs	t polarization splitter positioned adjacent to the first filter stage,
10	the first pola	rization splitter splitting the optical signal into two orthogonal
l 1	polarizations	s.
1	22	The Character is 21 and a single first differential delay.
1	32.	The filter of claim 31, wherein the first differential delay
2	includes a fir	xed portion and a tunable portion.
1	33.	The filter of claim 31, wherein the first differential delay
2	includes a fir	rst fixed differential delay and a first tunable differential delay
3	with the first	and second tunable delay paths.
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1	34.	The filter of claim 33, wherein the first fixed differential
2	delay sets a	periodic variation in a power spectrum of the optical signal.

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optical signal.

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delay sets a phase of the periodic variation in the power spectrum of the

The filter of claim 33, wherein the first tunable differential

and

1	36.	The filter of claim 31, wherein the first polarization splitter is
2	a polarizatio	n walk-off crystal.
1	37.	The filter of claim 31, wherein the first polarization splitter is
2	a polarization	n beam splitter.
1	38.	The filter of claim 33, wherein the first fixed differential
2	delay is posit	tioned between the first tunable coupling member and the first
3	tunable diffe	rential delay.
1	39.	The filter of claim 33, wherein the first tunable differential
2	delay is posi	tioned between the first tunable coupling member and the first
3	fixed differen	ntial delay.
1	40.	The filter of claim 31, further comprising:
2	a firs	t half-wave plate positioned between the first polarization
3	splitter and t	he first stage.
1	41.	The filter of claim 31, further comprising:
2	a sec	ond stage including:
3	a sec	ond tunable coupling member;
4	a sec	ond differential delay with first and second tunable delay paths;

- wherein the second tunable coupling member adjusts an amount of power of the optical signal divided onto the first and second tunable delay paths of the second differential delay.
- 1 42. The filter of claim 41, wherein the second differential delay 2 includes a fixed portion and a tunable portion.

1	43.	The filter of claim 41, wherein the second differential delay
2	includes a sec	ond fixed differential delay and a second tunable differential
3	delay with the	e first and second tunable delay paths.
1	44.	The filter of claim 43, wherein the second fixed differential
2	delay sets a p	eriodic variation in a power spectrum of the optical signal.
1	45.	The filter of claim 43, wherein the second tunable differential
2	delay sets a p	hase of the periodic variation in the power spectrum of the
3	optical signal	
1	46.	The filter of claim 43, wherein the second fixed differential
2	delay is posit	ioned between the second tunable coupling member and the
3	second tunable	e differential delay.
1	47.	The filter of claim 43, wherein the second tunable differential
2	delay is posit	ioned between the second tunable coupling member and the
3	second fixed	differential delay.
1	48.	The filter of claim 43, further comprising:
2	a seco	and polarization splitter positioned adjacent to the first stage,
3	the second po	plarization splitter combining the two orthogonal polarizations.
1	49.	The filter of claim 48, further comprising:
2	a first	half-wave plate positioned between the first polarization
3	splitter and th	te first stage; and
4	•	and half-wave plate positioned between the second walk-off

crystal and the second stage.

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L	50.	The filter of claim 48, wherein the first and second
2	orthogonal p	olarizations of the optical signal travel independently through
3	the first and	second tunable differential delays.

- 1 51. The filter of claim 43, wherein each of the differential delays 2 is a polarization dependent differential delay.
- 1 52. The filter of claim 43, wherein the first fixed differential 2 delay generates a time differential delay between first and second 3 polarizations of the optical signal.
- 1 53. The filter of claim 43, wherein the first tunable differential 2 delay changes an optical phase between first and second polarizations of the 3 optical signal.
- 1 54. The filter of claim 43, wherein the first tunable coupling 2 member is a polarization state transformer that transform the incoming 3 signal beam from one polarization state to a different polarization state.
 - 55. The filter of claim 43, wherein the first tunable differential delay modifies first and second polarizations of the optical signal with different phase relationships.
- 1 56. The filter of claim 43, wherein the first tunable coupling 2 member includes first and second liquid crystal alignment members coupled 3 to a voltage source.
- 1 57. The filter of claim 56, wherein liquid crystals in the first and second liquid crystal alignment members are orientated at different angles with respect to each other.

1	58.	The filter of claim 56, wherein liquid crystals in the first
2	liquid crystal	alignment member are orientated at 0 $^{\rm o}$ and the liquid crystals
2	in the second	liquid crystal alignment member are orientated at 90°.

- The filter of claim 43, wherein the first tunable differential delay includes first and second liquid crystal alignment members coupled to a voltage application member.
- 1 60. The filter of claim 59, wherein liquid crystals in the first and second liquid crystal alignment members are orientated at the same angle.
- 1 61. The filter of claim 59, wherein liquid crystals in the first and second liquid crystal alignment members are orientated at an orthogonal angle to each other.
- 1 62. The filter of claim 43, wherein each of the tunable coupling 2 members and the tunable differential delays is a liquid crystal tuning 3 element.
- 1 63. The filter of claim 43, wherein at least one of the tunable coupling members and the tunable differential delays is a Faraday rotation member.
- 1 64. The filter of claim 43, wherein at least one of the tunable coupling members and the tunable differential delays is a electro-optic member.
- 1 65. The filter of claim 43, wherein at least one of the tunable coupling members and the tunable differential delays is a thermal tuning member.